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OFFICE OF INDUSTRIAL TECHNOLOGIES

ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Benefits

- Reduced average daily energy use from over 10,000 kWh in 1986 to approximately 8,650 kWh in 1999, despite an increase in treatment capacity
- Increased system reliability
- Improved employee morale

Applications

Energy awareness, teamwork, and cooperation among system operators, plant engineers, and facility management can reduce costs and improve performance at any wastewater treatment system. For municipalities with high growth rates, a systems approach can be especially helpful in minimizing the costs associated with expanding plant capacity.

Performance Improvements at Wastewater Treatment Plants

The Project

For most facilities, identifying system performance improvements requires a coordinated effort between system operators and management. Operator familiarity with system performance, combined with proper training and management support, can provide useful recommendations that lead to lower system operating costs. Several examples of the success of such teamwork can be found at the City of Fairfield, Ohio Wastewater Division. This facility has repeatedly demonstrated that energy efficiency improvements not only reduce operating costs, but improve system performance as well.

Fairfield's proactive energy management policy includes:

- Motivating the participation of operators and management to obtain system data and develop feasible solutions;
- Coordinating the services of electric contractors, consultants, and their electricity provider and;
- Employing a systems approach to evaluate energy saving opportunities.

Fairfield Faculty and Staff

Systems Approach

Fairfield's success in improving system efficiency is largely attributable to their systems approach in developing solutions to the opportunities uncovered by their energy audits. Although some of their equipment upgrades were based on improving the wire-to-water efficiencies of specific equipment, other efficiency improvements were the result of an entire system analysis. Since the demand on Fairfield's wastewater treatment facility varies significantly over the course of a typical day, a systems approach was particularly effective in identifying ways to minimize the costs associated with this variability.

The systems approach proved exceptionally effective during Fairfield's attempt to limit their peak demand charges. After an energy audit revealed how high these costs were, Fairfield installed a power monitoring device, equipped it with an alarm capability, and interfaced it with the plant's computerized monitoring system. This provided plant operators with a status of various electrical loads. When a peak demand alarm was reached, plant operators had a list of equipment they could shut down without impairing treatment levels.

The systems approach also proved to be an effective asset management practice during facility expansions. Faced with a need to expand plant capacity, facility personnel identified an opportunity to replace aeration diffuser equipment with units that produce a significantly smaller diameter bubble. These smaller bubbles have more total surface area than larger bubbles. Because of this, more water could be treated without increasing the blower size.

Another example of Fairfield's effective system management is their extensive use of *MotorMaster+* software to track motor inventory and to store data such as peak kW, power factor, and total kWh. Many of Fairfield's motor decisions, such as whether to use premium efficiency motors and which motors to repair or replace, were facilitated using the *MotorMaster+* program.

Teamwork

Successful project implementation required good communication between operators, management, the city council, and Fairfield's electric contractors, consultants, and electricity provider. For instance, management approached the city council with its recommendation for a new system. Although management's choice was not the low bid, they convinced the council to approve the purchase by effectively communicating results of life-cycle cost

calculations, and demonstrating factors such as annual operating costs and total cost-per-million-gallons-pumped. Another example was management's recognition of their staff's effort by presenting the division with a plaque at the city's annual employee banquet. This has improved employee morale and communication between both parties.

Teamwork Between Operators and Management

As with any system improvement program, keeping all the stakeholders focused on the same objective is essential. Management must rely on system operators for data and feedback on equipment operation in order to evaluate ways to lower costs without degrading system performance. Similarly, system operators must have management support to obtain approval for system improvements.

At Fairfield, both management and system operators recognize that improving system efficiency not only reduces operating costs but also increases system reliability and extends equipment operating life. As the team produced results, other opportunities for additional system improvements became evident. Fairfield's success demonstrates that a coordinated energy management policy encourages facility personnel to participate in developing energy savings recommendations.

Energy Assessments

While working with electrical contractors, consulting firms, and Cinergy (their electric service provider), Fairfield frequently assessed their energy use to determine ways to reduce energy costs. They conducted reviews of their billing history, evaluated wire-to-water efficiencies of their pumping systems, conducted power quality testing, and constantly searched for cost improvement opportunities.

During a review of its electric rate schedule, Fairfield noticed that demand charges had the greatest impact on monthly energy costs. Fairfield installed a device that tracked electricity demand and connected it with an alarm that warned of peak load conditions. Using a systems approach to prioritize the operation of certain equipment, Fairfield provided system operators with a list of equipment to shut down when the facility approached peak load conditions.

Fairfield's success in limiting peak demand provided significant cost savings that motivated other searches into system improvement opportunities. In an effort to determine how efficient their systems were operating, Fairfield developed system curves for a number of different operating configurations and hired an electrical contractor to determine the wire-to-water efficiencies of

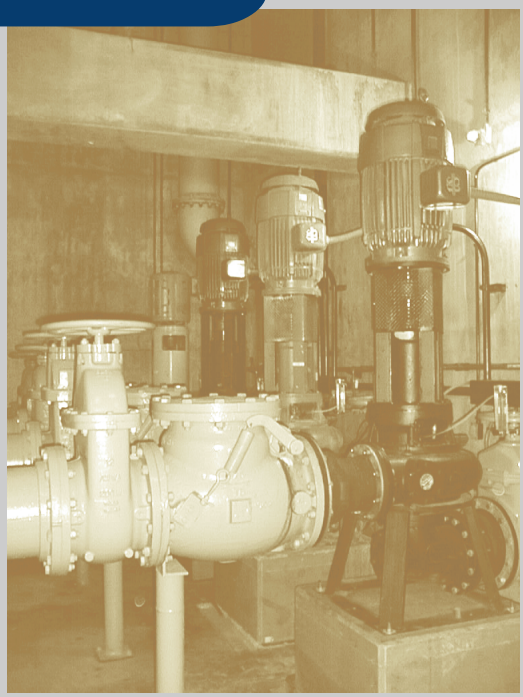
several pumps. The audit results indicated that there were attractive opportunities to reduce operating costs by replacing several older pumps and motors with newer, more efficient models. By replacing several of these pump/motor assemblies with more efficient units, Fairfield achieved payback periods of under 4 years. Other units were scheduled for upgrades on an as-they-fail basis.

Another energy cost that Fairfield's wastewater division repeatedly sought to minimize was the penalty associated with a low power factor. Since electricity providers usually assess cost penalties for drawing large amounts of reactive power, plants often install capacitors to add a leading power factor component. Fairfield's wastewater division installed capacitors on all major pieces of equipment to improve overall power factor, improve motor performance, and reduce energy bills.

Successes

Fairfield's energy management practices have lowered system operating costs and improved system performance for many years. Since the operating costs of a wastewater treatment facility depend on many external factors such as rainfall, the benefits of system improvements must be contrasted against costs without the improvements. With the exception of 1995 and 1996—years of heavy rainfall—average monthly energy use and peak power demand has declined since 1986. In addition to realizing lower operating costs, Fairfield's success is also evident in high employee morale that accompanies improved system performance.

PUMP SYSTEMS



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PROJECT PARTNERS

Cinergy
Cincinnati, OH

City of Fairfield
Ohio Wastewater Division
Fairfield, OH

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

OIT Clearinghouse
Phone: (800) 862-2086
Fax: (360) 586-8303
clearinghouse@ee.doe.gov

Visit our home page at
www.oit.doe.gov

Please send any comments, questions, or suggestions to
webmaster.oit@ee.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy, EE-20
U.S. Department of Energy
Washington, D.C. 20585

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